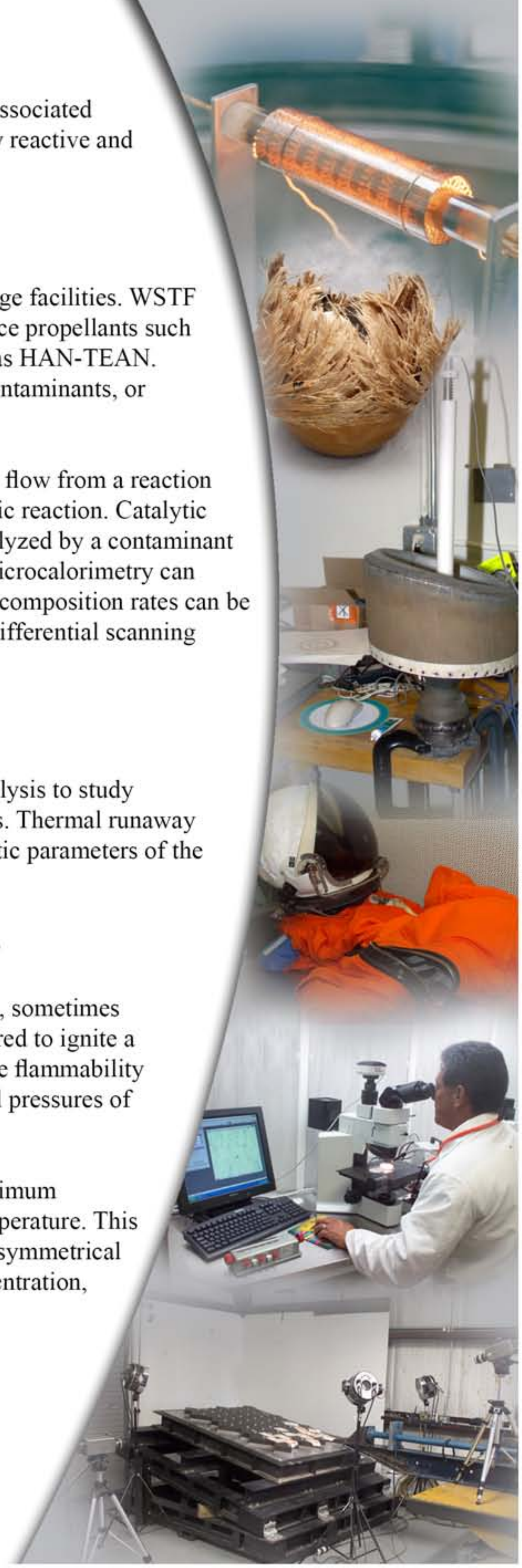
National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
WHITE SANDS TEST FACILITY



THERMAL AND IGNITION HAZARDS

SUMMARY

White Sands Test Facility (WSTF) performs testing to understand the hazards associated with energetic materials such as aerospace propellants. These materials are very reactive and there are hazards associated with stability, thermal runaway, and flammability.

STABILITY AND SHELF LIFE

Stability of propellants is a concern for spacecraft propulsion systems and storage facilities. WSTF performs testing to determine the stability and materials interactions of aerospace propellants such as hydrogen peroxide, dinitrogen tetroxide, and experimental propellants such as HAN-TEAN. Stability of the propellant in contact with the materials in storage containers, contaminants, or stabilizing additives can be determined.

WSTF uses the technique of isothermal microcalorimetry, which measures heat flow from a reaction vessel to a constant temperature heat sink, to determine the rate of an exothermic reaction. Catalytic decomposition of a propellant in contact with a surface and decomposition catalyzed by a contaminant or autocatalytic decomposition are some of the reactions that can be studied. Microcalorimetry can detect heat evolution on the order of 5 μJ per second, so even extremely low decomposition rates can be measured. Microcalorimetry is approximately 1000 times more sensitive than differential scanning calorimetry or accelerating rate calorimetry.

THERMAL RUNAWAY

WSTF utilizes accelerating rate calorimetry (ARC) and differential thermal analysis to study exothermic reactions that may lead to thermal runaway under certain conditions. Thermal runaway may occur when heat generated by a reaction is not removed fast enough. Kinetic parameters of the reactions can be determined, allowing prediction of hazardous situations.

MINIMUM IGNITION ENERGY AND FLAMMABILITY LIMITS

Important parameters in assessing ignition hazards are lower flammability limit, sometimes expressed in terms of the flash point, and the minimum amount of energy required to ignite a flammable mixture. WSTF uses ASTM and custom methods for determining the flammability limits for fuels as a function of concentration, temperature, pressure, and partial pressures of oxygen.

WSTF has developed a custom, stop flow system suited to determining the minimum ignition energy (MIE) of reactive aerospace fuels that are liquid at ambient temperature. This system is useful for liquid fuels such as ethanol, monomethylhydrazine, and unsymmetrical dimethylhydrazine. The MIE can also be determined as a function of fuel concentration, oxygen concentration, and total pressure.

CONTACT

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